

CLAIMS

1. An exposure apparatus that exposes a substrate by irradiating the substrate with exposure light through a projection optical system and a liquid, comprising:
 - 5 a liquid supply mechanism that supplies the liquid between an image plane side tip part of the projection optical system and an object that opposes the tip part;
 - a timer that measures the time that has elapsed since the supply of the liquid by the liquid supply mechanism was started; and
 - a control apparatus that determines, based on a measurement result of the timer, whether
10 a space, which is between the image plane side tip part of the projection optical system and the object and includes at least an optical path of the exposure light, is filled with the liquid.
2. An exposure apparatus according to Claim 1, wherein
15 the control apparatus determines, based on the measurement result of the timer, that the space is filled with the liquid when the time that has elapsed since the supply of the liquid was started reaches a prescribed time.
3. An exposure apparatus according to Claim 1 or Claim 2, wherein
20 the liquid supply mechanism comprises a supply port, which supplies the liquid, and a valve, which opens and closes a passage that is connected to the supply port; and the timer starts the measurement of time when the valve has opened the passage.
4. An exposure apparatus according to Claim 1, comprising:
25 a detector that detects a gas portion in the liquid;

wherein,

after the control apparatus determines that the space is filled with the liquid, it detects a gas portion in the liquid that filled the space.

- 5 5. An exposure apparatus according to Claim 1, wherein
after the control apparatus determines that the space is filled with the liquid, it irradiates
the exposure light.
6. An exposure apparatus that exposes a substrate by irradiating the substrate with exposure
10 light through a projection optical system and a liquid, comprising:
a liquid supply mechanism that supplies the liquid between an image plane side tip part
of the projection optical system and an object that opposes the tip part;
a timer that measures the time that has elapsed since the supply of the liquid by the liquid
supply mechanism was stopped;
15 a liquid recovery mechanism that recovers the liquid while the liquid is being supplied by
the liquid supply mechanism, as well as after such supply has stopped; and
a control apparatus that determines, based on a measurement result of the timer, whether
the liquid has been recovered from the space between the image plane side tip part of the
projection optical system and the object.
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7. An exposure apparatus according to Claim 6, wherein
the control apparatus determines, based on the measurement result of the timer, that the
liquid has been recovered from the space when the time that has elapsed since the supply
of the liquid was stopped reaches a prescribed time.

8. An exposure apparatus according to Claim 6 or Claim 7, wherein the liquid supply mechanism comprises a supply port, which supplies the liquid, and a valve, which opens and closes a passage that is connected to the supply port; and the timer starts the measurement of time when the valve has closed the passage.

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9. An exposure apparatus that exposes a substrate by irradiating the substrate with exposure light through a projection optical system and a liquid, comprising:

a liquid supply mechanism that supplies the liquid between an image plane side tip part of the projection optical system and an object that opposes the tip part;

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a liquid recovery mechanism that recovers the liquid;

a first measuring instrument that measures the amount of liquid supplied by the liquid supply mechanism;

a second measuring instrument that measures the amount of liquid recovered by the liquid recovery mechanism; and

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a control apparatus that determines, based on the measurement results of the first measuring instrument and the second measuring instrument, whether a space, which is between the image plane side tip part of the projection optical system and an object opposing the tip part and includes at least an optical path of the exposure light, is filled with the liquid.

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10. An exposure apparatus according to Claim 9, wherein the control apparatus determines that the space is filled with the liquid when the difference between the measurement result of the first measuring instrument and the measurement result of the second measuring instrument falls below a prescribed value.

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11. An exposure apparatus according to Claim 9 or Claim 10, wherein
the control apparatus determines, based on the difference between the measurement result
of the first measuring instrument and the measurement result of the second measuring
instrument, whether an abnormality has occurred.
12. An exposure apparatus according to Claim 9, wherein
after the control apparatus determines that the space is filled with the liquid, it irradiates
the exposure light.
13. An exposure apparatus that exposes a substrate by irradiating the substrate with exposure
light through a projection optical system and a liquid, comprising:
a liquid supply mechanism that supplies the liquid to a space between an image plane
side tip part of the projection optical system and an object that opposes the tip part;
a liquid recovery mechanism that recovers the liquid;
a measuring instrument that measures the amount of liquid recovered by the liquid
recovery mechanism since the supply of the liquid by the liquid supply mechanism was
stopped; and
a control apparatus that determines, based on the measurement result of the measuring
instrument, whether the liquid has been recovered from the space.
14. An exposure apparatus according to Claim 13, wherein
the liquid is recovered while moving a recovery port of the liquid recovery mechanism
and the object relative to one another.

15. An exposure apparatus according to Claim 13 or Claim 14, wherein
the object includes the substrate or a movable substrate stage that holds the substrate; and
the liquid is filled between the projection optical system and the substrate or a prescribed
region on the substrate stage.

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16. A supplying method that supplies a liquid to a space between an image plane side tip part
of a projection optical system and an object that opposes the tip part, comprising the steps of:

supplying the liquid to the space;

measuring the time that has elapsed since the start of the supply; and

- 10 determining that the space is filled with the liquid at a point in time when the elapsed
time exceeds a prescribed time.

17. A supplying method that supplies a liquid to a space between an image plane side tip part
of a projection optical system and an object that opposes the tip part, comprising the steps of:

15 simultaneously supplying and recovering the liquid to and from the space;

measuring an amount of liquid supplied and an amount of liquid recovered per unit of
time; and

- 20 determining that the space is filled with the liquid at at least one of the point in time when
the difference between the amount supplied and the amount recovered has become less
than a prescribed value, or the point in time when a prescribed time has elapsed since the
difference between the amount supplied and the amount recovered became less than the
prescribed value.

18. A supplying method according to Claim 16 or Claim 17, comprising the step of:

exposing a substrate by irradiating the substrate with exposure light through a projection optical system and the liquid after determining that the space is filled with the liquid.

19. A recovering method that recovers a liquid that is filled in a space between an image plane side tip part of a projection optical system and an object that opposes the tip part, comprising the steps of:

simultaneously supplying and recovering the liquid to and from the space;

stopping the supply of the liquid;

measuring the time that has elapsed since the stopping; and

determining that the recovery of the liquid that filled the space is complete at the point in time when the elapsed time exceeds a prescribed time.

20. A recovering method that recovers a liquid that fills a space between an image plane side tip part of a projection optical system and an object that opposes the tip part, comprising the steps of:

simultaneously supplying and recovering the liquid to and from the space;

measuring an amount of liquid supplied and an amount of liquid recovered per unit of time;

stopping the supply of the liquid; and

determining that the recovery of the liquid that fills the space is complete at at least one of the point in time when the amount recovered has become less than a prescribed amount, or the point in time when a prescribed time has elapsed since the amount recovered became less than a prescribed value.

21. A recovering method according to Claim 19 or Claim 20, comprising the steps of:

exposing a substrate by irradiating the substrate with exposure light through the projection optical system and the liquid prior to stopping the supply of the liquid; and unloading the substrate after it is determined that the recovery of the liquid that filled the space is complete.

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22. An exposing method that supplies a liquid to a space, which is between an image plane side tip part of a projection optical system and an object that opposes the tip part, and exposes the object through the liquid, comprising the step of:

supplying the liquid using the supplying method according to any one claim of Claim 16 through Claim 18.

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23. An exposing method that supplies a liquid to a space, which is between an image plane side tip part of a projection optical system and an object that opposes the tip part, and exposes the object through the liquid, comprising the step of:

recovering the liquid using the recovering method according to any one claim of Claim 19 through Claim 21.

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24. A device fabricating method, comprising the step of:
using an exposure apparatus according to any one claim of Claim 1 through Claim 15.